Service Instructions

1/3 Octave Filter

valid from serial no. 412027

Trouble Shooting

If any faults should occur please check the instrument according to the "Adjustment Procedure".

When a fault has been traced and corrected, the voltage and adjustments influenced by the correction must be rechecked.

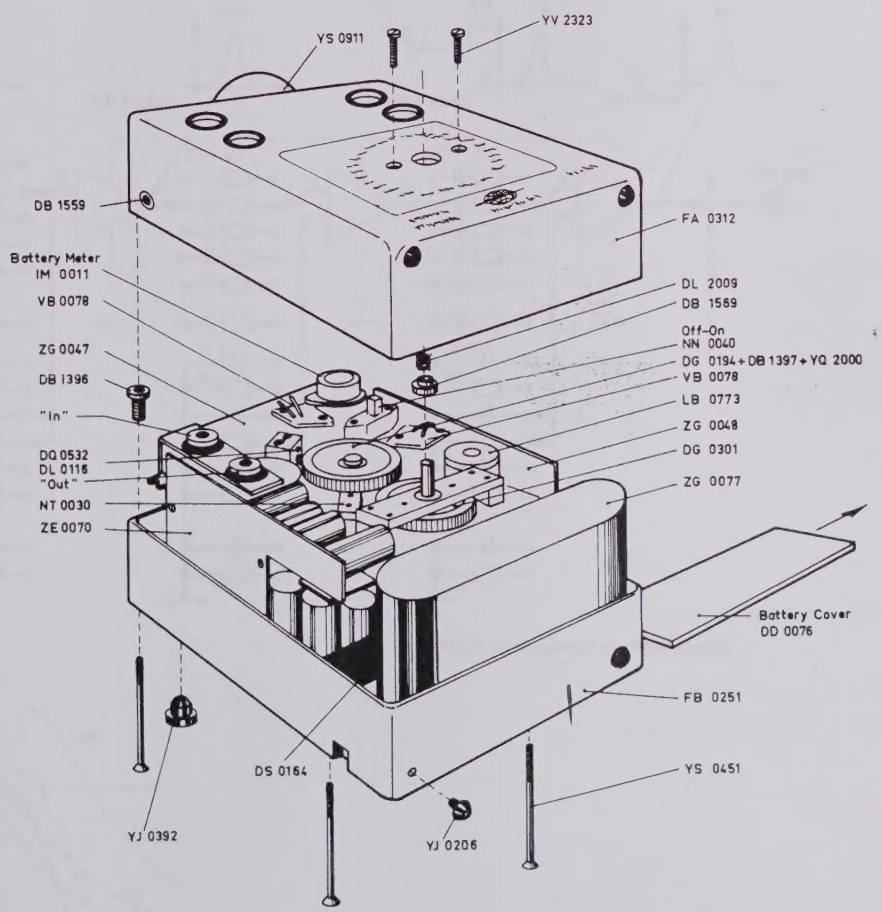
The complete instrument should then be rechecked according to the "Adjustment Procedure" to make sure that all basic functions are operative.

The tolerances in these notes are intended for use as a guide for adjustment.

Before correcting any apparent deviation make sure that the measuring instrument has tolerances small enough not to affect the measurement.

Spare Parts

Please state type and serial number of the 1/3 Octave Filter when ordering spare parts.



Notice!

In order not to damage the contact sets when removing the rotary built-in amplifier a piece of cartoon should be used. Place the cartoon over a fixed contact sets. Turn the rotary contact sets over the cartoon. Now the amplifier can be removed carefully.

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Technical Description

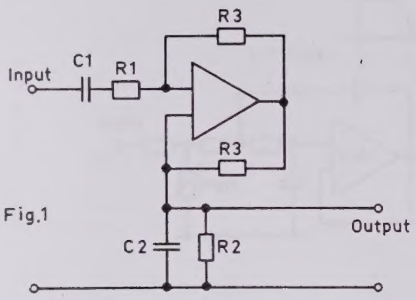


Fig.1

Simplified diagram of an "INIC"

The Type 1616 1/3 Octave Filter consists mainly of three equal Band Pass filter circuits, each consisting of an "INIC". (Ideal current-inversion Negative-Immitance Converter).

By using this filter type only two capacitors and two resistors must be changed when changing filter frequency (C_1 R_1 – C_2 R_2).

The feedback through R 3 controls the amplification of the filter independently of the input frequency.

In order to get a high input impedance of the INIC a source follower and an emitter follower are used as well.

A low output impedance is made by means of an amplifier with a high degree of feedback.

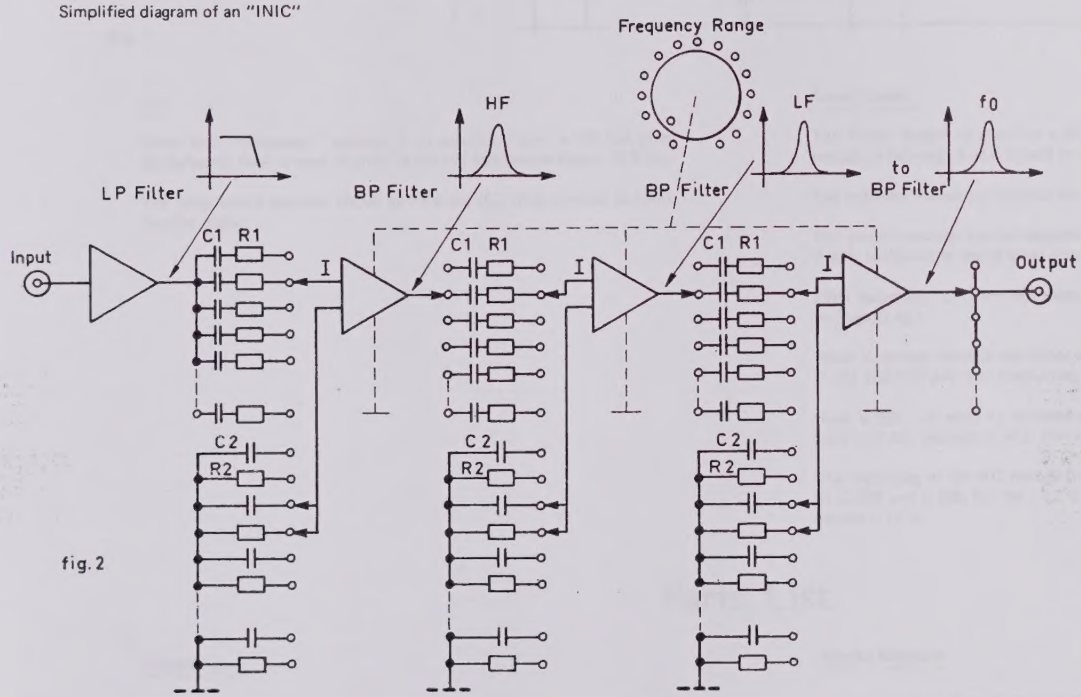


fig. 2

Simplified diagram of the Filter Circuits

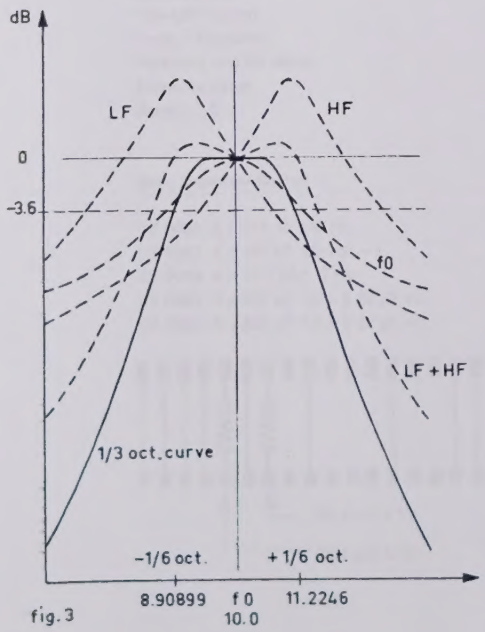


fig. 3

1/3 Octave Filters

In order to damp the high frequencies outside the bandpass range a filter is used in the input circuit. The filter is formed as a 2 pole "Bessel" filter, which suppress the "overshoot" of the transient response.

The filter cut-off frequencies above 40 kHz.

Then the signal is fed to the first INIC through an RC combination. (R_1 C_1) selected by the "Frequency" knob. The "Frequency"selector also changes the parallel combination (C_2 R_2) on the output of the INIC.

The three INIC's forms the HF, LF and the f_o bandpass curves which combined gives the output 1/3 octave filter curve.

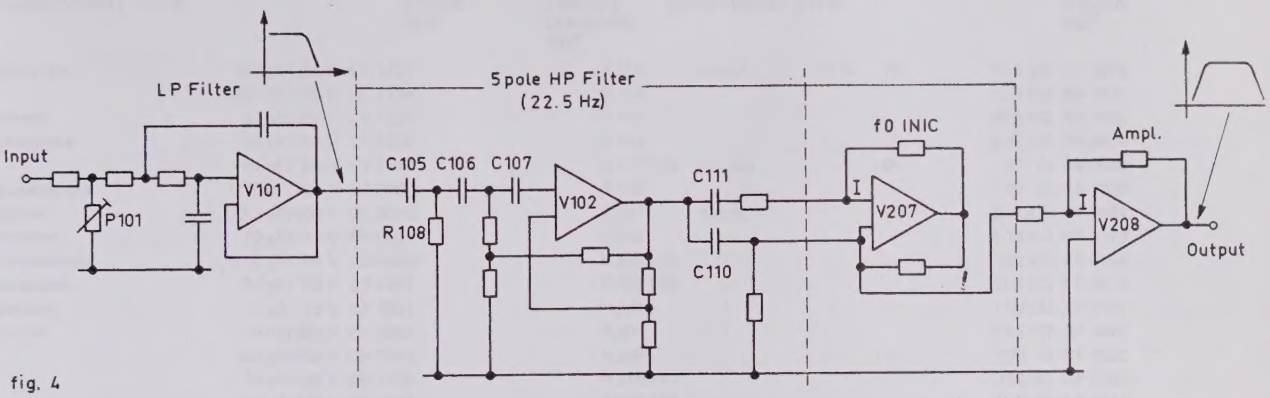


fig. 4

Lin

When the "Frequency" selector is in position "Lin" a HP five pole Butterworth filter is used in order to cut-off frequencies below 22.5 Hz.

The filter uses a separate circuit and the last (f_o) INIC in order to form the five poles.

Power Supply

The Power Supply is made as a DC to DC converter having an input voltage of between 3–4.6 V, and an output voltage of ± 12 V.

The oscillator frequency is about 50–60 kHz.

The output voltage can be regulated by means of the potentiometer P 401. (Referred to the original diagram.)

After switching ' On" the instrument V 401 becomes collector voltage through Q 401.

When a voltage through the diode Q 402 and P 401 are fed to V 401, V 401 and 402 will start conducting.

Now V 501 will start to oscillate giving a voltage of approx. –12 V back to P 401 through R 402. This voltage is controlled by Q 403.

The rectifying of the AC voltage from the oscillator is done by means of Q 502 and C 505 for the –12 V and C 504 and the transistor V 501 for the + 12 V.

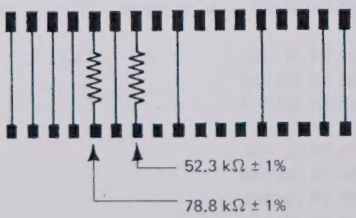
Parts List

Miscellaneous

Battery Meter	IM 0011
"On-Off" switch	NN 0040
Knob, "Frequency	SN 5005
Retaining ring for above	DB 0850
Screw for above	YQ 2083
Battery 1.5 V	QB 0004

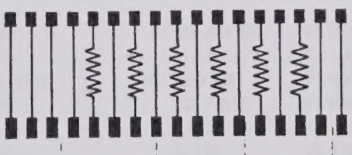
Spec. Capacitor Boards

CZ 0001 3 x 101 nF ±0.1%
CZ 0002 3 x 101 nF ±0.1%
CZ 0003 6 x 10.1 nF± 0.1%
CZ 0004 6 x 965 pF ±6 x 6-22 pF var.
CZ 0005 6 x 365 pF ±6 x 6-22 pF var.



RZ 0017

Special Resistors



RZ 0007–0016

RZ	Ω ± 0.1%	Ω ± 0.1%	Ω ± 0.1%
0007	71763	86915	78976
0008	57004	69039	62733
0009	45280	58480	49831
0010	35967	43561	39581
0011	28569	34601	31441
0012	22694	27485	24975
0013	18026	21832	19838
0014	14319	17342	15758
0015	11374	13775	12517
0016	9034.4	10942	9942.5

Parts List

CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
C 101	Polystyrene		820 pF/ 63 V	CT 1121
C 102	-		680 pF/125 V	CT 1134
C 103	Ceramic		22 pF/400 V	CK 1220
C 105	Polystyrene		36 nF/ 63 V	CT 1520
C 106	-		82 nF/ 63 V	CT 1547
C 107	Polycarbonate		0.15 µF/160 V	CS 0809
C 108	Ceramic		3.3 pF/400 V	CK 0330
C 109	Tantalum		22 µF/ 16 V	CF 0031
C 110	Polycarbonate		0.15 µF/160 V	CS 0809
C 111	Polystyrene		82 nF/ 63 V	CT 1547
C 112-114	Tantalum		22 µF/ 16 V	CF 0031
C 201	Ceramic		3.9 nF/250 V	CK 0391
C 202	-		500 pF/400 V	CK 0083
C 203	-		10 pF/400 V	CK 1100
C 204	-		150 pF/400 V	CK 2151
C 205	Tantalum		10 µF/ 3 V	CF 0032
C 206	Ceramic		6.8 pF/400 V	CK 0680
C 207	-		3.9 pF/250 V	CK 0391
C 208	-		500 pF/400 V	CK 0083
C 209	-		10 pF/400 V	CK 1100
C 210	-		150 pF/400 V	CK 2151
C 211	-		6.8 pF/400 V	CK 0680
C 212-214	Tantalum		10 µF/ 3 V	CF 0032
C 301	Ceramic		3.9 pF/250 V	CK 0391
C 302	-		500 pF/400 V	CK 0083
C 304	-		150 pF/400 V	CK 2151
C 305	-		6.8 pF/400 V	CK 0680
C 306,307	-		4.7 nF/1000 V	CK 0096
C 308,309	Tantalum		10 µF/ 3 V	CF 0032
C 310	Ceramic		10 pF/400 V	CK 1100
C 501	Tantalum		47 µF/ 6.3 V	CF 0023
C 502	-		22 µF/ 16 V	CF 0031
C 503	Polycarbonate		22 nF/250 V	CS 0005
C 504,505	Tantalum		22 µF/ 16 V	CF 0031
C 601	-		0.47 µF/ 35 V	CF 0027
C 701-703	Polystyrene		101 nF	CT 1554
C 801-803	-		101 nF	CT 1554
C 901-906	-		10.1 nF	CT 1555
C 1001-1006	Trimmer		6-22 pF/ 6.3 V	CV 0039
C 1007-1012	Polystyrene		965 pF/ 63 V	CT 3529
C 1101-1106	Trimmer		6-22 pF/ 63 V	CV 0039
C 1107-1112	Polystyrene		365 pF/ 63 V	CT 1172

P 101,102	Trimmer	lin. ± 20%	470 Ω	PG 1504
P 201,202	Minitrimmer	Cermet lin.	500 Ω	PG 1507
P 301	-	-	500 Ω	PG 1507
P 401	Trimmer	lin. 0.5 W	100 kΩ	PG 4108

Q 201,202	Si. diode	50 V/150 mA	BAX 13	QV 0223
Q 203,204	Ze. diode	5.9-6.5 V/ 5 mA	ZP 6.2	QV 1334
Q 206,207	Si. diode	50 V/150 mA	BAX 13	QV 0223
Q 208,209	Ze. diode	5.9-6.5 V/ 5 mA	ZP 6.2	QV 1334
Q 301,302	Si. diode	50 V/150 mA	BAX 13	QV 0223
Q 303,304	Ze. diode	5.9-6.5 V/ 5 mA	ZP 6.2	QV 1334
Q 401	Si. diode	50 V/150 mA	BAX 13	QV 0223
Q 402	Ge. diode	25 V/110 mA	OA 47	QV 0094
Q 403	Ze. diode	6-7.5 V/ 5 mA	ZG 6.8	QV 1106
Q 501,502	Ge. diode	25 V/110 mA	OA 47	QV 0094

R 101	Metal	1/4 W	1%	121 Ω	RF 2121
R 102	-	-	-	8.87 kΩ	RF 3887
R 103	-	-	-	1.18 kΩ	RF 3118
R 104	-	-	-	1.05 kΩ	RF 3105
R 105	-	-	-	787 Ω	RF 2787
R 108	-	-	-	93.1 kΩ	RF 4931
R 109	-	-	-	80.6 kΩ	RF 4806
R 110	-	-	-	1.15 kΩ	RF 3115
R 111	-	-	-	133 Ω	RF 2133
R 112	-	-	-	12.7 kΩ	RF 4127

CIRCUIT DIAGRAM REF.	COMPONENT TYPE			STOCK REF.
R 113	Metal	1/4 W	1%	97.6 kΩ RF 4976
R 114	-	-	-	93.1 kΩ RF 4931
R 115	-	-	-	97.6 kΩ RF 4976
R 116	-	-	-	5.76 kΩ RF 3576
R 117,118	Carbon	-	5%	47 Ω RB 1470
R 119	-	-	-	22 Ω RB 1220
R 201	Metal	-	1%	8.87 kΩ RF 3887
R 202	-	-	-	4.75 kΩ RF 3475
R 203,204	-	-	-	100 kΩ RF 5100
R 205,206	-	-	-	31.6 kΩ RF 4316
R 207	-	-	-	1.50 kΩ RF 3150
R 208	-	-	-	4.99 kΩ RF 3499
R 209	-	-	-	200 Ω RF 2200
R 210,211	-	-	-	100 kΩ RF 5100
R 212,213	-	-	-	31.6 kΩ RF 4316
R 214	-	-	-	21.5 kΩ RF 4215
R 215	-	-	-	8.87 kΩ RF 3887
R 216	-	-	-	4.75 kΩ RF 3475
R 217,218	-	-	-	100 kΩ RF 5100
R 219,220	-	-	-	31.6 kΩ RF 4316
R 221	-	-	-	1.50 kΩ RF 3150
R 222	-	-	-	4.99 kΩ RF 3499
R 223	-	-	-	200 kΩ RF 2200
R 224,225	-	-	-	100 kΩ RF 5100
R 226,227	-	-	-	31.6 kΩ RF 4316
R 228	-	-	-	56.2 kΩ RF 4562
R 229	-	-	-	100 Ω RF 2100
R 301	-	-	-	8.87 kΩ RF 3887
R 302	-	-	-	4.75 kΩ RF 3475
R 303,304	-	-	-	100 kΩ RF 5100
R 305,306	-	-	-	31.6 kΩ RF 4316
R 307	-	-	-	1.50 kΩ RF 3150
R 308	-	-	-	4.99 kΩ RF 3499
R 309	-	-	-	200 Ω RF 2200
R 310,311	-	-	-	100 kΩ RF 5100
R 312,313	-	-	-	31.6 kΩ RF 4316
R 314	-	-	-	13.7 kΩ RF 4137
R 402	Carbon	-	5%	12 kΩ RB 4120
R 501	-	-	-	39 kΩ RB 4390
R 502	-	-	-	47 kΩ RB 4470
R 601	-	1/8 W	10%	10MΩ RH 0902

V 101,102	Op. Amp.		LM 301 AN	VE 0017
V 201	FET dual		U 232	VB 1002
V 202	Si. Trans. dual	NPN	BCY 89	VB 5304
V 203	Op. Amp.		CE 709 C	VE 0003
V 204	-		LM 301 AN	VE 0017
V 205	FET dual		U 232	VB 1002
V 206	Si. Trans. dual	NPN	BCY 89	VB 5304
V 207	Op. Amp.		CE 709 C	VE 0003
V 208	-		LM 301 AN	VE 0017
V 301	FET dual		U 232	VB 1002
V 302	Si. Trans. dual	NPN	BCY 89	VB 5304
V 303	Op. Amp.		CE 709 C	VE 0003
V 304	-		LM 301 AN	VE 0017
V 401	Ge. Trans.	PNP	ASY 27	VB 0031
V 402	-	PNP	AD 162	VB 0078
V 501	-	PNP	AD 162	VB 0078

Printed Circuit Boards

with comp		without comp
ZE 0070	Input Amplifier	XC 0698
ZE 0071	Filter and Amplifier1	XC 0690
ZE 0072	Filter and Amplifier1	XC 0849
ZG 0047	Power Regulator	XC 0740
ZG 0048	Power Oscillator	XC 0739
CZ 0004	Trimmer Board	XC 0941
CZ 0005	Trimmer Board	XC 0942

Adjustment Procedure

1. Power Supply

Measure the DC voltage on C 112 to be + 12 V.
If necessary adjust P 401 on ZG 0047.

Power consumption approximately 220 mA.

2. Input Amplifier

"Input" signal 316 mV, 1 kHz correspond to full scale deflection on an B & K Electronic Voltmeter.

Measure the voltage on V 101 pin 6 to be 19.69 dB below the "Input" signal.
If necessary adjust P 101.

3. Filters: 20 – 160 Hz and 200 – 1600 Hz

FREQUENCY: "50 Hz"

Connect the voltmeter to the output of V 204. (Use the corresponding pin on the selector board.)

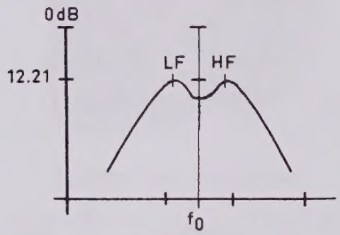
a. HF filter circuit

"Input" signal 316 mV. Vary the LF Generator frequency around 50 Hz in order to obtain the maximum output of the filter.

Adjust by means of P 201 the output voltage to be 8.5 dB below the "Input" signal.

b. LF filter circuit

Connect the voltmeter to the output of V 304.



"Input" signal 316 mV. Adjust the LF Generator frequency to maximum filter output voltage.

Notice! Use the lowest filter top as the HF curve will be seen as well.

Adjust the output voltage to 12.2 dB below the "Input" signal.

Check if the two tops are equal.

c. f_o filter circuit

"Input" signal 316 mV, 100 Hz.

Connect the voltmeter to the "Output".

Adjust by means of P 202 the "Output" voltage to be 0 dB.

Check item 3 a, b and c for the filters 20 – 160 Hz.

d. FREQUENCY: "500 Hz"

Repeat item 3 a, b and c, using an Input signal of 500 Hz.

Check item 3 a, b and c for the filters 200 – 1600 Hz.

4. Filters: 2 – 16 kHz

FREQUENCY: "5 kHz"

Check first that item 3 fulfilled the specification outlined above. Do not readjust any potentiometer unless it is strictly necessary.

a. HF filter circuit

"Input" signal 316 mV, 5 kHz.

Connect the voltmeter to the output of V 204 (pin 6).

Vary the "Input" frequency around 5 kHz in order to obtain the maximum output voltage.

Measure the voltage to be 8.5 dB below the "Input" signal.

Measure the frequency to be 5.52 kHz by means of a Frequency Counter.

If necessary adjust the trimmers C 1005 – 1006.

b. LF filter circuit

Connect the voltmeter to V 304 pin 6.

Adjust the voltage to be 12.21 dB below the "Input" signal, and the frequency to be 4.64 kHz by means of C 1003 – 1004.

c. f_o filter circuit

"Input" signal exactly 10 kHz, 316 mV.

Adjust C 1001 – 1002 to 0 dB at maximum level on "Output".

Check item 4 a, b and c for the filters 2 – 16 kHz.

5. Filters: 20 – 40 kHz

FREQUENCY: "31.5 kHz"

Check and adjust as mentioned in item 4, but use only the trimmers C 1101 – 1106.

Check item 5 for the filters 20 – 40 kHz.

6. HP Filter (Linear)

FREQUENCY: "Lin"

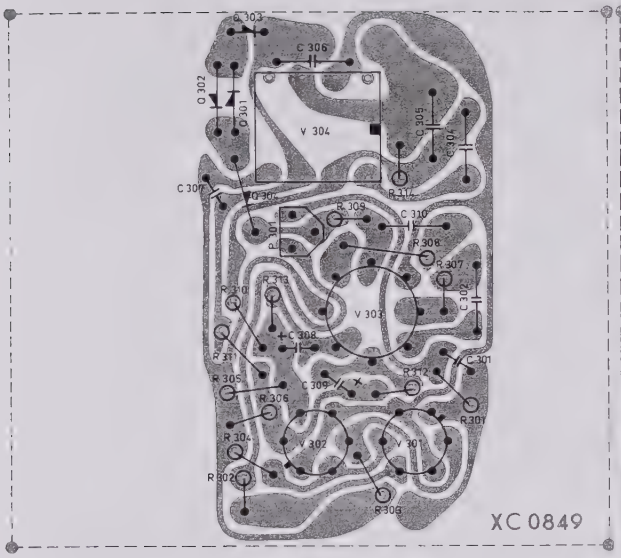
"Input" signal 316 mV, 1 kHz.

Adjust by means of P 102 the filter "Output" level to 0 dB.

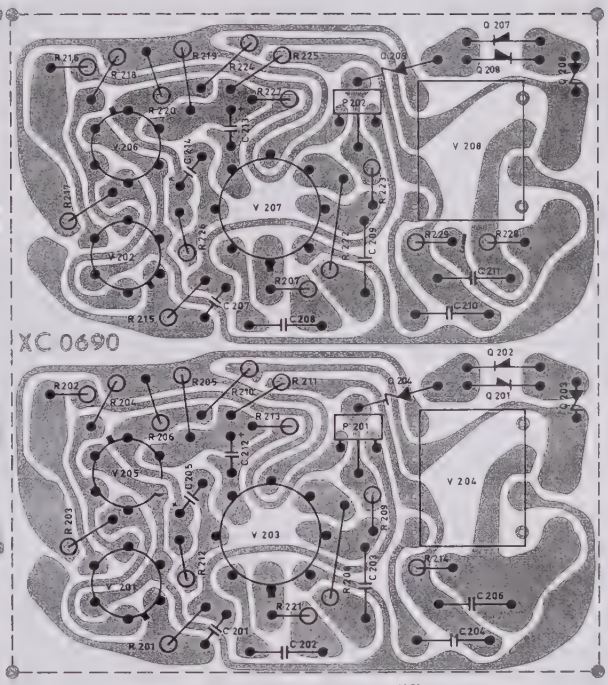
Filter Adjustment Frequencies

Centre frequency	f_o	10	12.5	16	20	25	31.5	40	50	63	80
HF resonant circuit	HF	11.00	13.85	17.44	21.96	27.64	34.80	43.81	55.16	69.44	87.42
HF + LF resonant circuit	LF	9.25	11.64	14.66	18.45	23.23	29.25	36.82	46.35	58.35	73.46

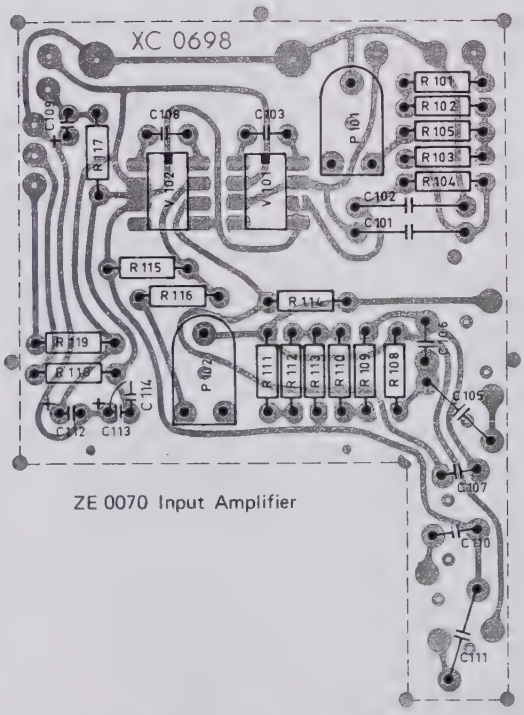
Layout Diagrams



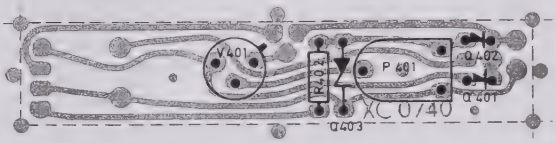
ZE 0072 Filter and Amplifier



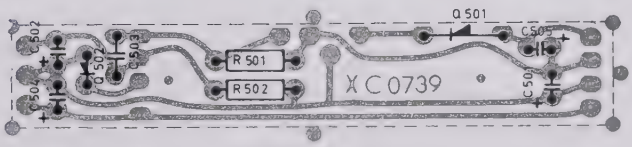
ZE 0071 Filter and Amplifier



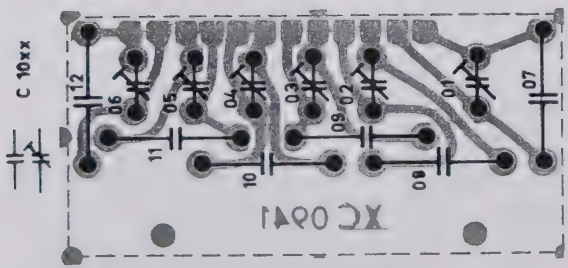
ZE 0070 Input Amplifier



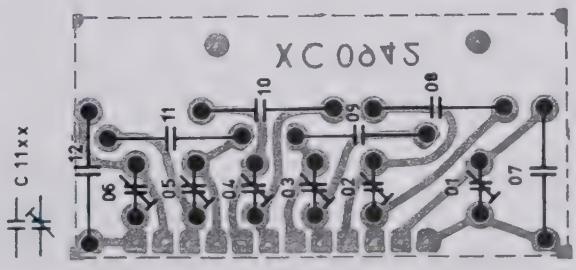
ZG 0047 Power Regulator



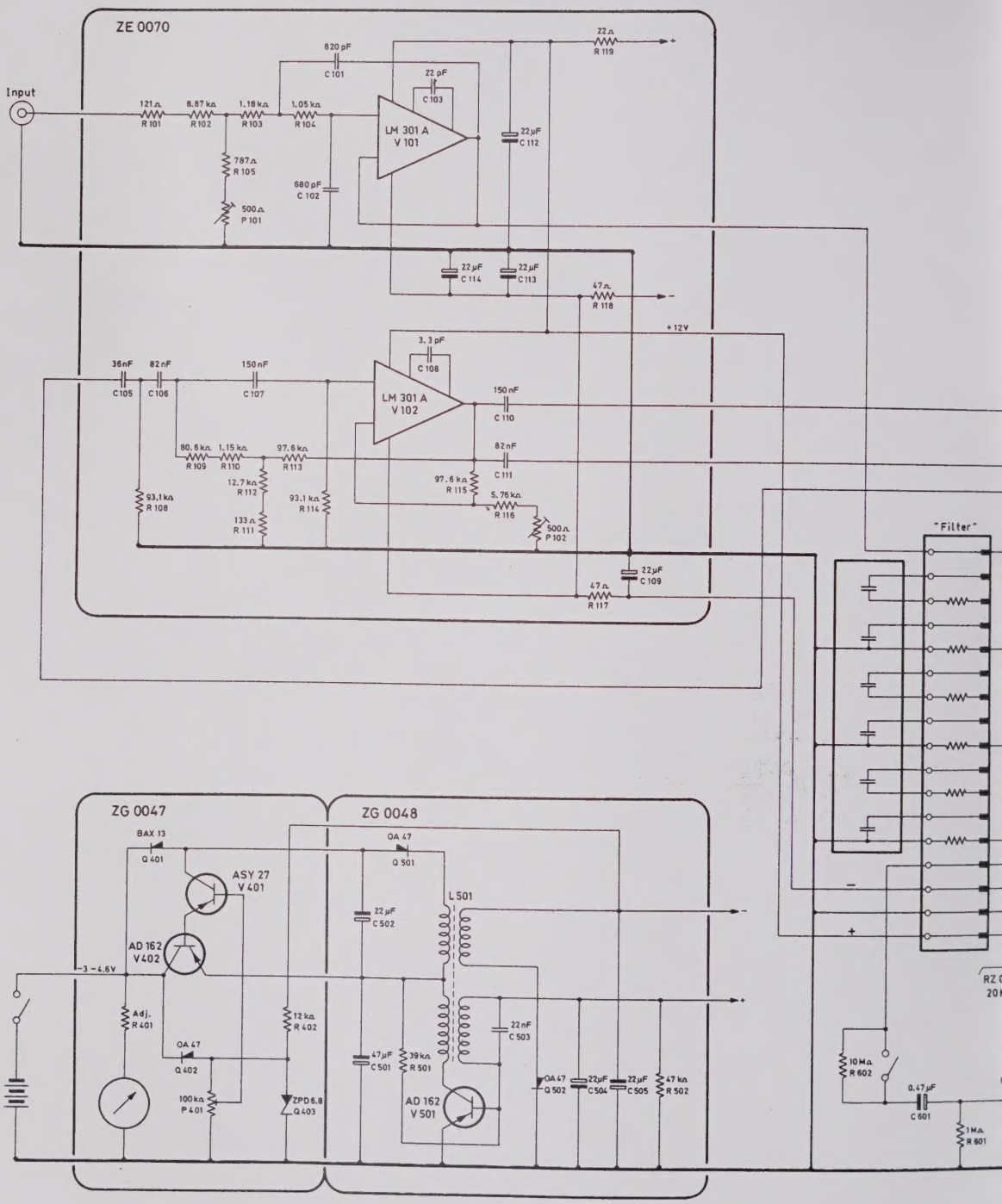
ZG 0048 Power Oscillator



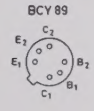
CZ 0004 Trimmer Board



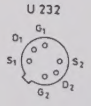
CZ 0005 Trimmer Board



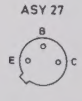
BCY 89



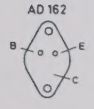
U 232



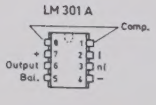
ASY 27



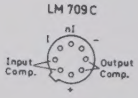
AD 162



LM 301 A

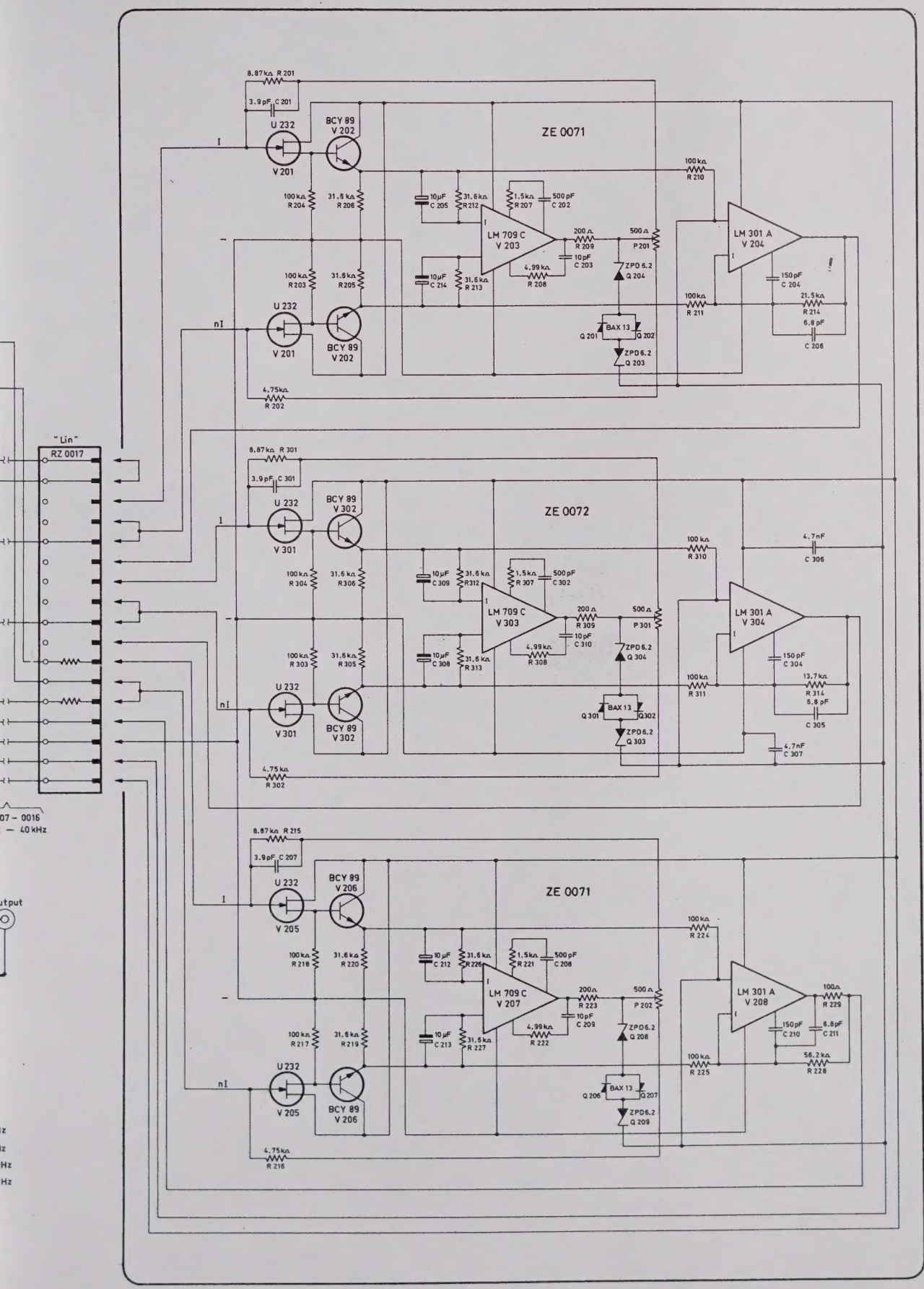


LM 709 C



Bottom view

CZ 0001 - 0002	RZ 0007 - 0016	20 - 160
CZ 0003	RZ 0007 - 0016	200 - 1600
CZ 0004	RZ 0007 - 0016	2 kHz - 16
CZ 0005	RZ 0013 - 0016	20 kHz - 40
	RZ 0017	"Lin"



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